Section 40 Portland Cement Concrete Pavement

Section 40
Portland Cement
Concrete
Pavement

4-4001 General

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General

This section covers portland cement concrete pavement. A concrete paving operation includes the following:

- The production of the portland cement concrete
- The placing, finishing, and curing of the concrete pavement
- The concrete pavement subgrade
- The specified equipment
- The construction of joints
- The protection of the pavement

Plant inspection specialists and acceptance testers not directly assigned to the resident engineer usually perform inspection and testing duties at the concrete batch plant. However, in addition to on-site inspection, mix design and plant inspection are part of the resident engineer's responsibility. Good communication is essential between plant and inspection specialists and assistant resident engineers. The resident engineer must be kept informed of test results in a timely manner.

This section will mostly cover on-site inspection duties. For information on producing and transporting portland cement concrete, see Section 4-90, "Portland Cement Concrete," of the *Construction Manual* (manual).

4-4002 Before Work Begins

4-4002
Before work begins

Before work begins, do the following:

- Review the plans and specifications to determine the requirements for portland cement concrete pavement, including thickness requirements, joint and tie bar details, and cement content requirements.
- Verify the receipt and proper distribution of Form CEM-3101, "Notice of Materials to Be Used," which lists materials for portland cement concrete pavement.
- In accord with the State Contract Act, check to ensure the aggregate source is a permitted site in compliance with the Surface Mining and Reclamation Act of 1975 (SMARA). Mining operations determined to be in compliance are listed on the AB 3098 SMARA Eligible List. You can obtain this list from the Division of Construction or the Department of Conservation's web site at http://www.consrv.ca.gov/omr/SMARA/3098-list. Also, see Section 7-103D to determine if the proposed materials site is exempt from SMARA.

- The specified cement content is based on the best information available to the project design engineer. The procedure to determine the actual cement content that will be used is as follows:

  1. To determine whether the cement content for the pavement is being reviewed, contact the Office of Materials Engineering and Testing Services (METS) at least 70 days before paving begins. The resident engineer must ensure the process has started. The district materials engineer may be a good initial contact.

  2. METS may perform the required testing to determine cement content or may establish cement content based on previous testing of aggregates from the same source. If METS has received Form CEM 3101, "Notice of Materials to Be Used," action will probably have been initiated to determine the cement content. If METS needs samples of aggregate for testing, the resident engineer will be advised. Either district materials laboratory personnel or project personnel may obtain the samples.

  3. The resident engineer will be advised of the recommended cement content. If the recommended cement content and the specified cement content are different, prepare a contract change order to provide an adjustment in compensation in accordance with Section 40-1.015, "Cement Content," of the *Standard Specifications*.

- Obtain initial samples and design the mix as covered in Section 4-90, "Portland Cement Concrete," of this manual. For assistance with the mix design process when needed, contact the district materials engineer or responsible unit.

- Well before paving begins, contact the district materials engineer to make arrangements for measuring pavement thickness. Personnel from the district materials laboratory or METS may take core samples for thickness measurements or you may need to initiate a service contract for taking core samples.

- Decide whether crossings will be necessary for the convenience of public traffic and whether Type III portland cement should be used for such crossings. Advise the contractor accordingly.

- Examine the equipment or tools to be used. When obvious inadequacies exist, advise the contractor and enter the details in the daily report. More specifically, do the following in examining equipment or tools:

  1. For side-form construction:

     a. Examine the forms to ensure the specified attributes, including those for composition, weight, dimensions, and rigidity. Ensure the forms are cleaned and oiled before each use.

     b. Ensure that installation of the forms complies with the specifications. Order any necessary corrective work before the placement of concrete.

     c. Inspect the paving equipment for specification compliance.

  2. For slip-form construction, examine the paver for the specified attributes. Require the specified demonstration of satisfactory operation and note such activity in the daily report.

3. To ensure compliance with the requirements for protecting pavement, examine all equipment that will bear on previously completed pavement.

- Before the start of paving, check the accuracy of the final grade stakes.
- Inspect the subgrade to ensure compliance with the specified tolerances for compaction and elevation. Ensure that any low areas are identified in a manner that will result in placing additional concrete as specified. Such additional thickness is considered paid for as part of the lower layer and must not be included when calculating pavement thickness. (See the specifications for cement-treated base, lean concrete base, and treated permeable bases.)
- To maintain the concrete pavement at the thickness specified, the contractor may adjust the planned finished grade provided two conditions are met:

  1. All lower layers have been constructed to at least the minimum required elevations.
  2. Such adjustments do not result in abrupt changes in grade or adversely affect smoothness.

- An acceptable general practice is to limit any such adjustment so that the planned finished grade does not change more than 10 mm in 15 m longitudinally.
- When slip-form pavers are used, inspect the grade upon which the paver will ride to determine if the grade is smooth enough to prevent abrupt vertical changes in the finished surface. When a wire controls the grade and alignment of the paver, check the wire for any obvious variations. Ensure the wire is tensioned sufficiently to prevent any measurable sag between supporting stakes. Advise the contractor if you anticipate any problems. Keep in mind that the contractor is responsible for the thickness and smoothness of the pavement.
- For determining pavement thickness (not for providing a seal), require the contractor to coat the surface of cement-treated permeable base with asphaltic emulsion.
- Ensure the contractor correctly applies the bond breaker material to the surface of lean concrete base.
- When pavement is to be placed during periods of low ambient temperatures, require the contractor to submit a written outline of proposed methods for protecting the concrete.
- Ascertain the curing method that the contractor proposes to use. When curing compound will be used, discuss with the contractor the labeling and packaging requirements for acceptance of the compound.
- Ensure the equipment for applying curing seal complies with the specifications.
- Before paving begins, ensure that the equipment for constructing joints is on-site and that it conforms to specifications.
- Before paving begins, ensure that equipment that meets the requirements of Section 90-7.01A, “Water Method,” of the *Standard Specifications* is on-site.
- If paving or finishing operations will extend beyond daylight hours, ensure that adequate lighting facilities are on the project before paving begins.
- When required, ensure that tie bars and dowels are on hand and conform to specifications.

- When long hauls are involved, review the contractor's proposed placement method to ensure adequate time will be available.
- Arrange for plant inspection and testing personnel to be present at the plant before start up.
- For California Test 523, "Flexural Strength of Concrete (Using Simple Beam with Center-point Loading)," select a location to store concrete beams. A good location is one that is convenient to a water source and removed from any traffic. Require the contractor to supply sufficient sand or earth for burying the beams. Arrange for the contractor to also supply labor for assistance with transporting and burying the beams. Note the safety precautions in the test method.
- Before placing concrete, require that the subgrade be uniformly moist.

4-4003 During the Course of Work

4-4003 During the Course of Work

During work, do the following:

- Before mixing, obtain samples of the aggregate, and test for the specified attributes in accordance with the frequency shown in Section 6-1, "Sample Types and Frequencies," of this manual. Initially, and in the case of borderline material, obtain and save additional samples so that if the first samples tested do not meet the requirements for contract acceptance, the extra samples may be tested to determine the extent of the failing material.
- When the results of grading tests, sand equivalent tests, or both are outside the limits for contract compliance, you must determine whether the portland cement concrete represented by the tests is structurally adequate. When concrete pavement that does not meet contract compliance is left in place, the contractor's specified payment is to be made by administrative deduction. Ensure the reasons for leaving the concrete in place are fully documented, and notify the contractor of your decision and the deduction amount to be made.
- Before accepting lower limits for the cleanness value and sand equivalent value in accordance with Section 90-2.02A, "Coarse Aggregate," and Section 90-2.02B, "Fine Aggregate," of the *Standard Specifications*, ensure the contractor complies fully with the requirements for certificates of compliance.
- See Section 4-90, "Portland Cement Concrete," of this manual for a discussion of transporting concrete and receiving load tickets at the delivery point. Decide if delivery tickets should be required.
- Engineers inspecting the placing portion of the operation must maintain good contact with engineers inspecting operations at the mixing plant, so that any problems related to mixing or hauling may be addressed and corrected.
- Observe the concrete as it is placed for any improper proportions or inadequate mixing. In the daily report, record the reasons for any concrete rejection and the approximate amount involved.
- Ensure the contractor furnishes the required tachometer. Also, ensure the contractor does the vibrating at the locations and in the frequencies and amplitudes specified. Be alert for inoperative units, and have them replaced immediately.
- Obtain samples of the concrete, and perform tests in accordance with the frequencies shown in Section 6-1 of this manual.

- Observe the operation of equipment that bears on existing pavements to ensure that no cracking or other damage occurs. If damage does occur, order immediate corrective action.
- Ensure that dowels and tie bars are not displaced during the pour.
- When joints are to be formed rather than sawed, ensure the joint material is placed as specified.
- At the start of each day's work, ensure that the specified date stamp is used to mark the new pavement.
- Ensure the contractor constructs a contact joint whenever a time interval is greater than that allowed by the specifications between any two successive concrete loads.
- Measure the pavement's width at the beginning of paving and periodically thereafter. While the required width applies to both upper and lower surfaces, the bottom width can be greater than specified to reduce edge slump.
- Ensure the contractor performs the preliminary finishing according to specifications and in a manner that will impart the desired surface characteristics.
- Encourage the contractor to construct the pavement so that before final finishing it meets the requirements for profile index, straightedge, and edge slump.
- During your observations, consider the following information:

    1. Pavement can be durable but have inadequate texture, or be well-textured and not possess enough durability to retain the texture.
    2. One of the things that reduces surface durability is mixing water with the surface mortar during finishing. This mixture may "bleed" water that has not evaporated water added to the surface to make finishing easier, or water added to prevent hairline cracking and checking.
    3. If any of the concrete visible during finishing is more dilute than the mortar of the freshly placed concrete, too much water is being mixed into the surface. Telltale signs of unacceptable practice include the following:

        a. Soupy mortar during finishing

        b. Excess laitance

        c. Small scallops in the slab's edge

        d. Areas in the finished surface that are still soft and wet while the surrounding area has turned firm and lost its watery sheen

    4. Standing bleed water may appear on the surface under certain conditions shortly after pavement is placed. To avoid mixing bleed water with surface grout, preliminary finishing should be completed before bleeding progresses to this degree.

5. Water applied for the convenience of finishing, not otherwise necessary to produce the product specified, is contrary to specifications regarding the use of water for retempering. The engineer must control the amount of any necessary fogging.

- Ensure the contractor performs the final finishing as specified and in a manner that will result in a finished surface with the desired characteristics.
- When sufficient rain may fall to damage fresh pavement, as defined in the specifications for protecting concrete, stop the placing or ensure other steps are taken (such as placing a covering) to prevent damage.
- Before texturing, ensure the contractor rounds the pavement edges to the specified radii. Observe texturing for compliance with requirements. Initial texturing is to be done with a broom or burlap drag so as to produce striations parallel with the centerline.
- Ensure burlap drags are used as specified and kept sufficiently clean to avoid unsightly irregularities in the texture. Brooms used instead of burlap drags also must be kept sufficiently clean to avoid significant irregularities. Final texturing must be done with spring steel tines that produce grooves parallel with the centerline. Grooves that are not straight and parallel to the centerline are unacceptable. Ensure the cross section of the steel tines complies with the specifications. Inspect the pavement surface to ensure the grooves meet the specified depth.
- Both before and after the application of curing seal, ensure the contractor keeps the pavement surface moist as specified.
- Ensure the contractor uses one of the curing methods specified in Section 90-7.02, "Curing Pavement," of the *Standard Specifications*. During your observations, also do the following:

1. Waterproof Membrane:

    a. Before placing the membrane, ensure the contractor sprays the concrete with a mist of water until the concrete has set.

    b. Examine waterproof paper or plastic sheeting to ensure it meets specifications. If you need assistance, consult with the district materials engineer.

    c. Ensure that sheeting material is placed and secured and that any damaged sheeting is repaired as required in the specifications. Ensure the contractor adheres to the specified curing period.

2. Curing Compound:

    a. Examine shipments of curing compound to ensure the compound is labeled and packaged as specified. If the compound is shipped in tanks or tank trucks, obtain a copy of the shipping invoice, and determine whether it contains the specified information. Prohibit the use of improperly identified curing compound until it has been sampled and tested. See Section 6-2, "Acceptance of Material and Sampling Methods," of this manual for procedures.

b. For acceptance tests, obtain samples of the curing compound as required under Section 6-1, "Sample Types and Frequencies," of this manual.

c. Ensure the contractor uniformly applies the curing compound at the specified time. See that sawed cuts, or any other areas that have been disturbed, receive additional curing compound. Your inspection should ensure the following attributes for the compound:

(1) It is not contaminated, diluted, or altered in any way before application.

(2) It is mixed thoroughly before application.

(3) It is applied when concrete surfaces are still visibly moist.

(4) The curing film remains unbroken for the specified duration of curing.

d. Perform measurements and calculations for the curing seal's application rate. To determine the application rate, you may also use California Test 535, "Determining the Application Rates of Concrete Curing Compounds in the Field". Record such measurements in the daily report.

e. Decide whether fogging the concrete pavement will be necessary after the curing seal has been applied, as described in Section 90-7.02, "Curing Pavement," of the *Standard Specifications*.

- Observe the sawing of weakened plane joints. Check the spacing and location for conformance with the plans. Measure the cuts to determine whether they meet the specified dimensions. Sawed-joint specifications regarding depth and width apply to the completed joint. During your inspection of the sawing of weakened plane joints, also do the following:

  1. Since joint saws commonly employ multiple blades, ensure that each one cuts to the specified width and depth. Frequently, portions of joints cut by different blades do not meet. If so, you will need to order blade realignment.

  2. Although the contractor is responsible for controlling the exact time of sawing weakened plane joints, ensure that sawing is completed within the time limits specified. Control joints, because of their function to relieve early drying and thermal shrinkage stresses, must be cut soon after the concrete has hardened enough to support the saw.

  3. When volunteer cracking starts, the slab is in tension and further sawing will result in cracks ahead of the saw cut.

- With the district materials engineer, arrange to measure the coefficient of friction (California Test 342, "Surface Skid Resistance with the California Portable Skid Tester"). Also, note the following:

  1. Areas with uniform surface texture require testing only at representative locations to ensure that the required coefficient of friction has been provided. Test areas with visibly smoother texture as completely as necessary to ensure compliance or to delineate areas that must be corrected.

2. Tests made at temperatures below 4.5°C will yield low results; therefore, do not rely on such tests as indications of failure. However, you may use values higher than the required minimum to indicate compliance even if you made measurements at temperatures below 4.5°C.

3. To determine whether the contractor's method of texturing is capable of producing the specified results, perform some tests as soon as possible after paving begins. Note that tests performed before the concrete is seven days old are not valid for acceptance. Whenever early tests are performed, advise the contractor that such areas are subject to retesting. If the contractor has used the pavement for hauling or conducted any operation that could reduce the friction factor from the one originally determined, retest such areas before opening them to public traffic.

- Make arrangements with the district materials laboratory to make thickness measurements of the completed concrete pavement. For more details about pavement thickness measurements, see the information under the heading "Measurement and Payment" below. In general, perform coring as soon as practical, with due consideration for the reasonable employment of coring crews and efficiency of operation. If the paving operation is going to last more than a few days, make a reasonable effort to obtain the first cores at an early date for the informational value to the resident engineer and contractor. Do not allow coring machines on fresh concrete while any danger exists of damaging the concrete. Seventy-two hours is considered the minimum period to wait.
- Measure the finished surface with a straightedge, especially at contact joints, to determine compliance with the specifications. The pavement's final surface must comply with both the straightedge and profilograph requirements.
- Observe the contractor's pavement profiling operation. Ensure that the profilograph is calibrated and that the contractor operates the profilograph in accordance with California Test 526, "Operation of California Profilograph and Evaluation of Profiles". The contractor is responsible for controlling and performing all the intermediate steps necessary to produce final profilograms that indicate the pavement surface is within the profile index specified. Read the final profilograms in a timely manner. Inform the contractor if the profile index is acceptable or if further grinding is required. Record details of the contractor's profilograph operation, corrective measures, and final profilogram results in the daily report.
- Ensure the concrete pavement is protected as specified. Make additional sets of beams to determine acceptable flexural strength when pavement crossings are to be opened to public traffic or to job traffic earlier than normally permitted.
- Before opening the pavement to public traffic, require the contractor to repair spalls, raveling, and tearing in sawed joints, as specified.
- Ensure that end anchors are constructed at all required locations and to the dimensions shown on the plans. Ensure transverse contact joints are constructed and tie bars and dowels are placed as shown on the plans. When required, ensure that pressure relief joints are constructed as specified and shown on the plans.

4-4004 Measurement and Payment

Using the dimensions shown on the plans, calculate the quantity of portland cement concrete pavement to be paid for. Use curve corrections to ensure the calculations account for curves in alignment. Make deductions from contract payments for deficient pavement thickness.

4-4004A Measurement of Pavement Thickness

Cores taken in each primary unit of pavement at the minimum rate specified, and additional cores in primary unit areas taken at the contractor's request, are referred to as primary cores.

Primary cores do not include cores taken for secondary thickness measurements. Cores taken for secondary thickness measurements, and cores taken to determine the limits of secondary units, are referred to as secondary cores.

Before coring begins in primary units, designate areas where coring is excluded. Limit excluded areas to the following:

- Dig-out spots in the subgrade
- Thickened slabs at bridge approaches
- End anchors
- Any local areas where authorized modifications to the planned pavement thickness have been permitted

Do not exclude portions of the primary unit where equipment had difficulty or where other unauthorized deviations from planned pavement thickness occurred.

4-4004A (1) Location of Primary Cores

Do the following to locate primary cores:

- For each day of paving, determine the net length of pavement placed, excluding the length of structures and other areas upon which pavement is not placed during that day. The resulting measurement is the length of the primary unit. Multiply the net length by the number of lanes in the primary unit. Divide that number by 300 m and take the next highest whole number. The resulting number is the number of primary cores to be taken, unless the contractor requests additional cores.
- Divide the net length of the primary unit by the number of primary cores to be taken in that unit. The resulting distance will be referred to as the primary coring interval.

Locate the first core in any primary unit by starting at either end of the unit (preferably proceeding in the direction of increasing stations), and select any lane at random. Select any factor from the longitudinal factors shown in Table 4-40.1, "Calculation Factors to Locate Cores." Multiply the factor by the primary coring interval. The result will be the distance from the beginning of the primary unit to the first core. (Any random method of selecting the longitudinal location of the first core is within the intent of the specification.) Determine the lateral location of the first core by selecting a value from the lateral column shown in Table 4-40.1 and measuring that distance from the right-hand edge (when looking ahead) of the lane selected.

Table 4-40.1 Calculation Factors to Locate Cores

Longitudinal (Factor)	Lateral (Meters)
0.6	1.8
0.1	3.0
0.2	0.6
0.9	2.7
0.5	1.5
0.7	2.1
0.4	1.2
0.8	2.4
0.3	0.9

- In turn, locate the remaining primary cores in the lanes. Space them uniformly, from the first core in the unit, at longitudinal intervals equal in length to the primary coring interval for the unit. Then locate them laterally within each lane in the manner used for the first core by applying successive values from the lateral factors in table 4-40.1. All values in the table are to be used successively for each primary unit throughout the project after the value for the first core in the unit is selected at random. The location of each core should be spotted on the pavement within "pacing accuracy" longitudinally and within about 0.3 m laterally.

4-4004A (2) Location of Secondary Cores

To determine the limits of secondary units, locate cores approximately in the center of each adjacent panel.

4-4004A (3) Thickness Variation

For all cores, determine the pavement thickness variation by subtracting the specified thickness of pavement from the thickness determined by core measurements. (Record excess thickness by using the plus sign and deficient thickness using the minus sign.)

4-4004B Calculation of Deductions in Payment to the Contractor for Deficient Thickness

The following covers the steps to take when calculating deductions in payment based on deficient thickness:

4-4004B (1) Adjustment When None of the Primary Cores Is Deficient in Thickness by More Than 15 mm

The following describes how to make an adjustment when none of the primary cores are deficient in thickness by more than 15 mm:

- To determine the average thickness deficiency, if any, for the primary unit, average the thickness variations of all primary cores. Record this value to the nearest 2.5 mm. If the average thickness deficiency is less than 2.5 mm, do not make a deficiency adjustment. If the average thickness deficiency is more than 2.5 mm, continue with the steps in the bullets below.
- To obtain the deficiency adjustment in dollars per square meter, use the table in Section 40-1.135A, "Thickness Deficiency of Not More Than 15 mm," of the *Standard Specifications*.

- To obtain the total amount of payment to be deducted for the primary unit, multiply the deficiency adjustment by the total area of the primary unit in square meters.

4-4004B (2) Adjustment When One or More of the Primary Cores Is Deficient in Thickness by More Than 15 mm

When one or more cores are deficient in thickness by more than 15 mm, determine the total adjustment by using the following procedure:

- To determine the secondary unit adjustment, multiply the area of any panels deficient in thickness by more than 15 mm that are allowed to remain in place by the dollar figure specified in Section 40-1.135B, "Thickness Deficiency of More Than 15 mm," of the *Standard Specifications*.
- In the calculation to determine average thickness of the primary unit, use the average thickness of all secondary cores outside each secondary unit to replace the thickness of the initial core within that secondary unit.
- To determine the primary unit deduction, multiply the primary unit area, excluding any secondary unit areas, by the appropriate factor (if any) in the table in Section 40-1.135A, "Thickness Deficiency of Not More Than 15 mm," of the *Standard Specifications*.
- To determine the total deduction, add the deductions for the primary unit, any secondary units, and the cost of all secondary cores, including those taken outside secondary units.

The following is an example illustrating the procedure for measuring the pavement for thickness and calculating deductions for thickness deficiencies. The procedures and the dollar figures used for deductions from payments to the contractor used in the example are based on Section 40-1.135, "Pavement Thickness" of the *Standard Specifications(1999 edition).*

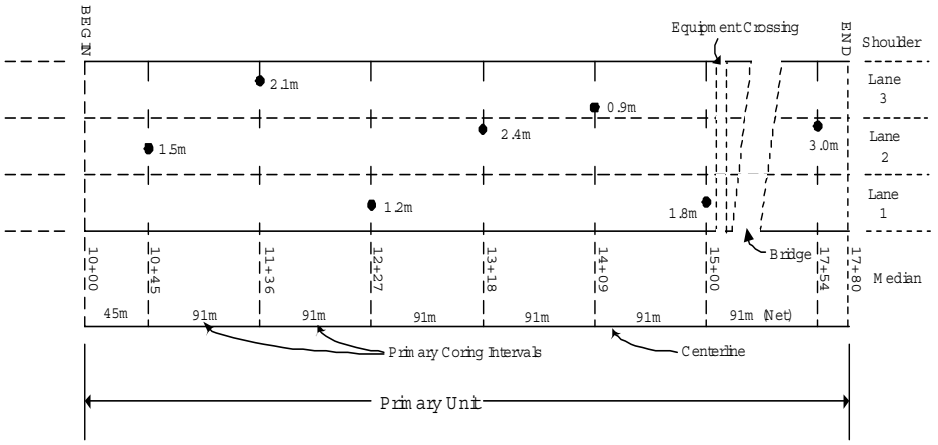
Assume the following:

The contractor paved three lanes (lanes 1, 2, and 3) from Station 10+00 to Station 17+80. An equipment crossing and a bridge within the limits of the day's run caused "skips" in the length paved totaling 140 m. The actual length paved was 640 m.

The engineer calculated the number of cores required for thickness measurements in the primary unit and the core interval. To determine the location of the first core, the engineer chose the center lane (Lane 2), at random, and used the fifth set of numbers, at random, from Table 4-40.1 "Calculation Factors to Locate Cores." The first core was taken at a longitudinal distance from the beginning of 45 m (approximately the core interval) and at a lateral distance of 1.5 m from the right edge of the lane. Figure 4-40.1, "Primary Core Locations", illustrates the primary unit and the location of all the primary cores.

Figure 4-40.1

Primary Core Locations



a. Length of Primary Unit = 640 m

b. Number of Cores

$$\frac{3 \text{ lanes} \times 640\text{m}}{300} = 7 \text{ cores}$$

$$\frac{640\text{m}}{7 \text{ cores}} = 91.4 \text{ meters/core, use } 91\text{m}$$

c. Location of the First Primary Core

In this example the center lane is chosen (at random), and the fifth set of numbers (at random) from the table above is used. The first core is taken at a longitudinal distance from the beginning of 45.5m (0.5 x 91m). A distance rounded to 45m is used in the example. The first core is taken 1.5m from the right edge of the lane.

The core thickness variations for the respective numbered cores were determined as follows:

Core Number	Thickness Variation
1.	-7.5 mm
2.	+5 mm
3.	+7.5 mm (use +5 mm)
4.	-7.5 mm
5.	-10 mm
6.	-0 mm
7.	-20 mm

Core 3 is more than 5 mm greater than the specified thickness, so + 5 mm was used in the calculation to determine thickness deficiency in the primary unit in accordance with Section 40-1.135A, "Thickness Deficiency of Not More Than 15 mm" of the Standard Specifications.

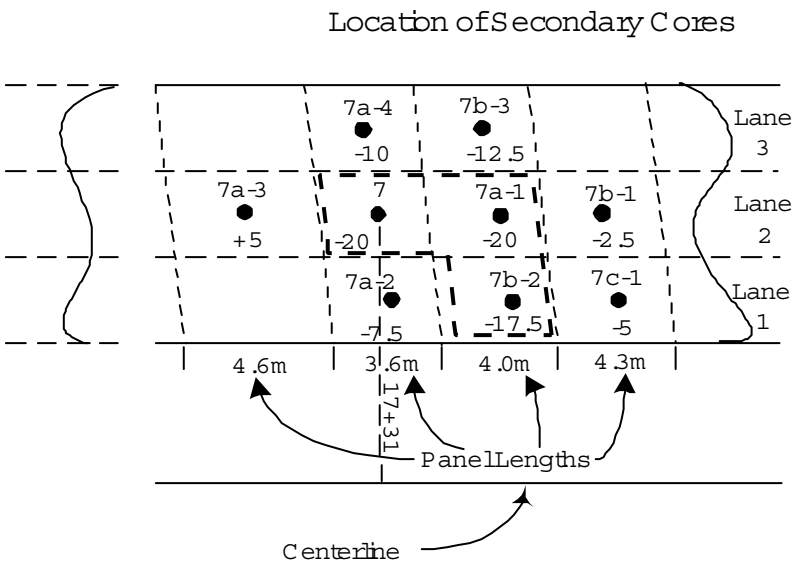
Core 7 was deficient by more than 15 mm. Because of this deficiency, the next step was to determine, from secondary thickness measurements, the dimensions of the secondary unit.

To determine the limits of the secondary unit, the resident engineer ordered secondary thickness measurements to be made in the panels adjacent to the panel in which Core 7 was taken. Subsequent thickness measurements were made in panels adjacent to any of these panels that had thickness deficiencies of more than 15 mm. This process continued until the secondary unit was bounded by panels in which the secondary measurements were deficient in thickness by 15 mm, or less. The following columns show the resulting thickness variations in the secondary cores:

Core Number	Thickness Variation
7a-1	-20 mm
7a-2	-7.5 mm
7a-3	+5 mm
7a-4	-10 mm
7b-1	-2.5 mm
7b-2	-17.5 mm
7b-3	-12.5 mm
7c-1	-5 mm

Figure 4-40.2, “Location of Secondary Cores,” illustrates the secondary unit and the location of the panels in which secondary measurements were made.

Figure 4-40.2



The panels in the secondary area, represented by cores 7, 7a-1, and 7b-2, were measured and found to be 42 m.

The engineer averaged the thickness variations of the secondary thickness measurements outside of the secondary unit area. The resulting value was used, in lieu of the thickness variation for Core 7, in the calculation to determine the average thickness deficiency of the primary unit area. The core thickness variations in the panels surrounding the secondary unit are tabulated below.

Core Number	Thickness Variation
7a-2	-7.5
7a-3	+5 mm
7a-4	-10 mm
7b-1	-2.5 mm
7b-3	-12.5 mm
7c-1	-5 mm

The average of the thickness variations in the above table is –5.4 mm. This average was rounded down to –5.0 mm, and that value was used for the thickness variation for Core 7 in the primary unit.

Using –5 mm for the Core 7 thickness deficiency, the engineer calculated the average thickness deficiency (cores 1 through7) for the primary area to be –2.8 mm. This average was rounded down, and –2.5 mm was used for the thickness deficiency for the primary unit.

The remaining area of the primary unit, after the area of the secondary unit was subtracted, was as follows:

640 x 3 x 3.6 – 42 = 6,870 m.

The deduction from payment to the contractor for thickness deficiency in the primary area in accordance with Section 40-1.135A, "Thickness Deficiency of Not More Than 15 mm," of the *Standard Specifications* was calculated as follows:

6,870 m x $0.40 = $2,748.00

The engineer determined that the concrete in the secondary unit could be left in place. The deduction from payment to the contractor for the secondary unit, in accordance with Section 40-1.135B, "Thickness Deficiency of More Than 15 mm," of the *Standard Specifications*, was calculated as follows:

42 m x $32.50 = $1365.00

In addition to the deductions for pavement thickness deficiencies in the primary and secondary units, a deduction from payment to the contractor was made for the cost of all secondary thickness measurements. The cost of secondary thickness measurements was the cost of cores 7a-1 through 7a-4, 7b-1 through 7b-3, and 7c-1.

4-4004B (3) Contractor's Requests for Additional Thickness Measurements

If, after the primary coring is performed, the contractor requests additional thickness measurements within any primary unit, treat this request as a request for doubling the frequency of coring in the primary unit area. Locate the additional cores in a manner similar to that used for locating the primary cores. This approach will halve the interval distance between primary cores. To calculate the deficiency adjustment, do not separately consider additional cores that are deficient in thickness by no more than 15 mm. Instead, include these cores with the original primary cores. If any additional cores are deficient in thickness by more than 15 mm, determine the limits of the secondary areas.

Do not grant permission to any request from the contractor for selective coring. However, if the contractor requests additional thickness measurements before the performance of any of the primary coring, you may shorten the length of the coring interval for the primary unit accordingly. For example, the contractor may request a rate of one core for each 200 m of traffic lane rather than one core for each 300 m. This request will have the effect of increasing, but not necessarily doubling, the number of cores.

Deduct from the payment to the contractor the cost of all additional thickness measurements that resulted from the contractor's request.

If a contractor requests more than one round of additional cores, consult with the construction field coordinator before granting permission.

4-4004C Handling of Skips in the Original Day's Pour and Secondary Areas to Be Removed and Replaced

Skips (such as gaps left for traffic or equipment crossing, short distances between adjacent bridges, and secondary areas to be removed and replaced) ultimately are poured at a later date. The net area of such pavement placed in any one day technically becomes a primary unit area and, as such, is subject to the specifications regarding thickness measurements. Use judgment regarding which of these areas are of sufficient size to warrant thickness coring. In general, any area excluded from final coring should be small, and you must have other measurements to confirm that the thickness of the pavement is not deficient.

4-4004D Handling Deficient Areas Not Cored

When you have specific knowledge of areas deficient in thickness and you have records of the extent of such deficiency, exclude these areas from the random coring. Make the deficiency adjustment on the average thickness deficiency in the same manner as for areas that have been cored.

4-4004E Administration

Notify the contractor in writing of the date and place where coring will be performed. Follow up verbally, if necessary, to be certain that the contractor knows when and where coring will take place.

After measuring and recording pavement thickness, retain the cores until final agreement is reached on the payment for the portland cement concrete pavement. (Usually, final agreement is reached once the contractor returns the proposed final estimate.)

The personnel who measure core thickness prepare the coring records, which include information about the cores' location and measured thickness. The original records and one copy are given to the resident engineer, who will retain the original and forward the copy to the contractor. Personnel from the district materials laboratory will keep one copy and another copy is sent to METS in Sacramento.

Use Form TL-3096, "Pavement Core Record," which must include sketches showing the location of the cores. Separate reports should be prepared and identified for secondary area measurements. These reports will assist in determining the cost to the contractor for secondary coring and will provide a clear record of such secondary areas. Follow the same distribution of copies as for primary unit reports (as described in the previous paragraph).